(12) UK Patent Application (19) GB (11) 2 017 256 A

(21) Application No **7901026**
(22) Date of filing **12 Jan 1979**
(23) Claims filed **12 Jan 1979**
(30) Priority data
(31) **2801114**
(32) **12 Jan 1978**
(33) **Fed. Rep. of Germany (DE)**
(43) Application published
3 Oct 1979
(51) **INT CL²**
F16D 3/22
(52) Domestic classification
F2U 503 532 534 541
(56) Documents cited
None
(58) Field of search
F2U
(71) Applicant
Löhr & Bromkamp GmbH., Postfach 166, 6050 Offenbach/Main 1, Germany
(72) Inventors
Karl Damian, Gunter Gartner, Hans-Heinrich Welschof
(74) Agent
Forrester, Ketley & Co.

(54) Universal Joints

(57) A constant velocity ratio joint comprising an outer joint member 1 having grooves 3 on its inner surface and inner joint member 4 having grooves 5 on its outer surface a cage 7 positioned between the inner and outer joint members, the cage having windows in which balls 6 are located, the balls extending into the respective grooves in the inner joint member and the outer joint member to transmit torque between the two members, the outer joint member being provided with one or more end stop faces 11 at radius R, the inner joint member being provided with one or more corresponding counterfaces 12 such that plunging movement of the joint is limited by abutment between a respective end stop face and counterface. Axial movement in the opposite direction may also be limited by a further stop (17) Fig. 3 (not shown).

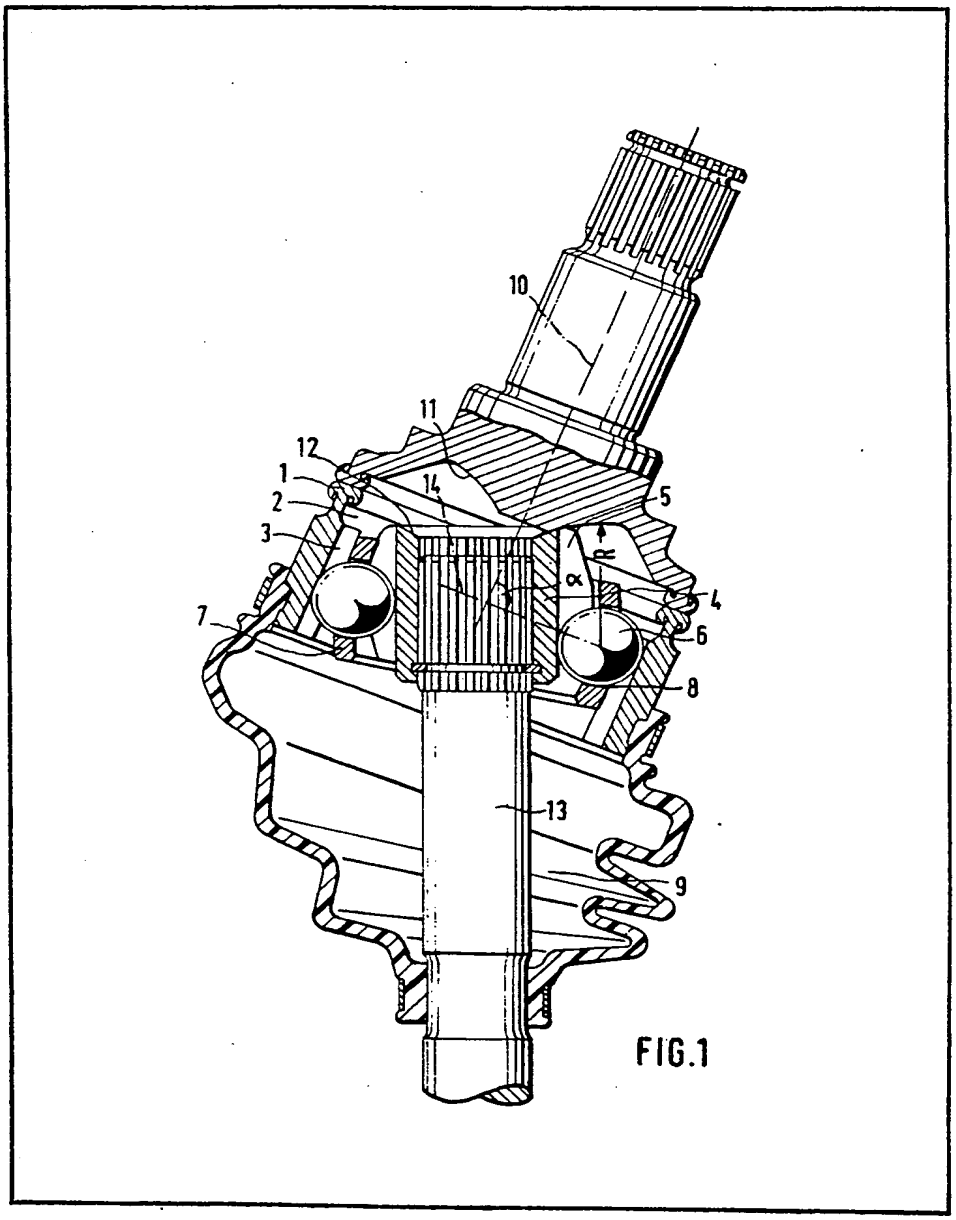

FIG.1

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

GB 2 017 256 A

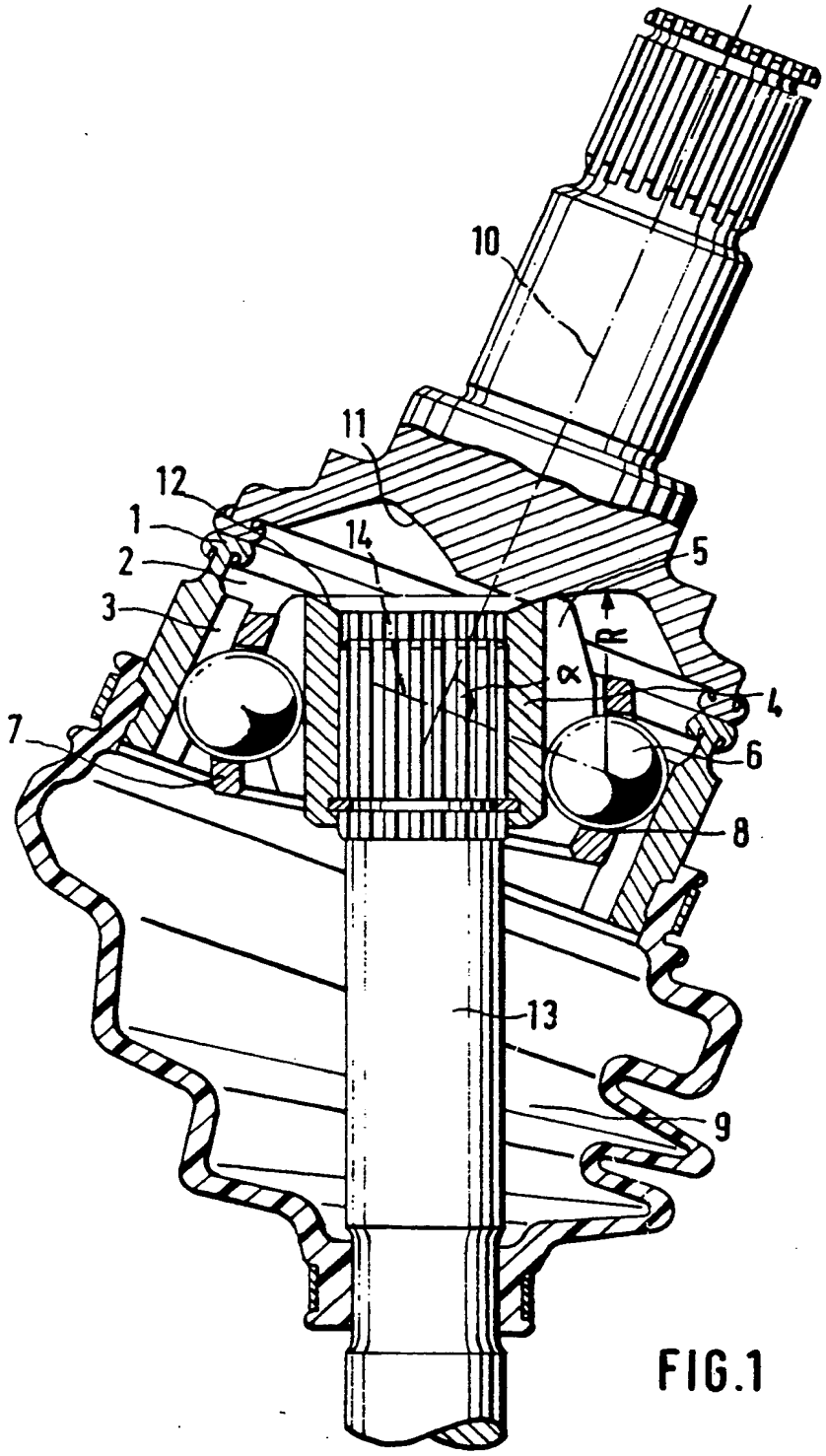

FIG.1

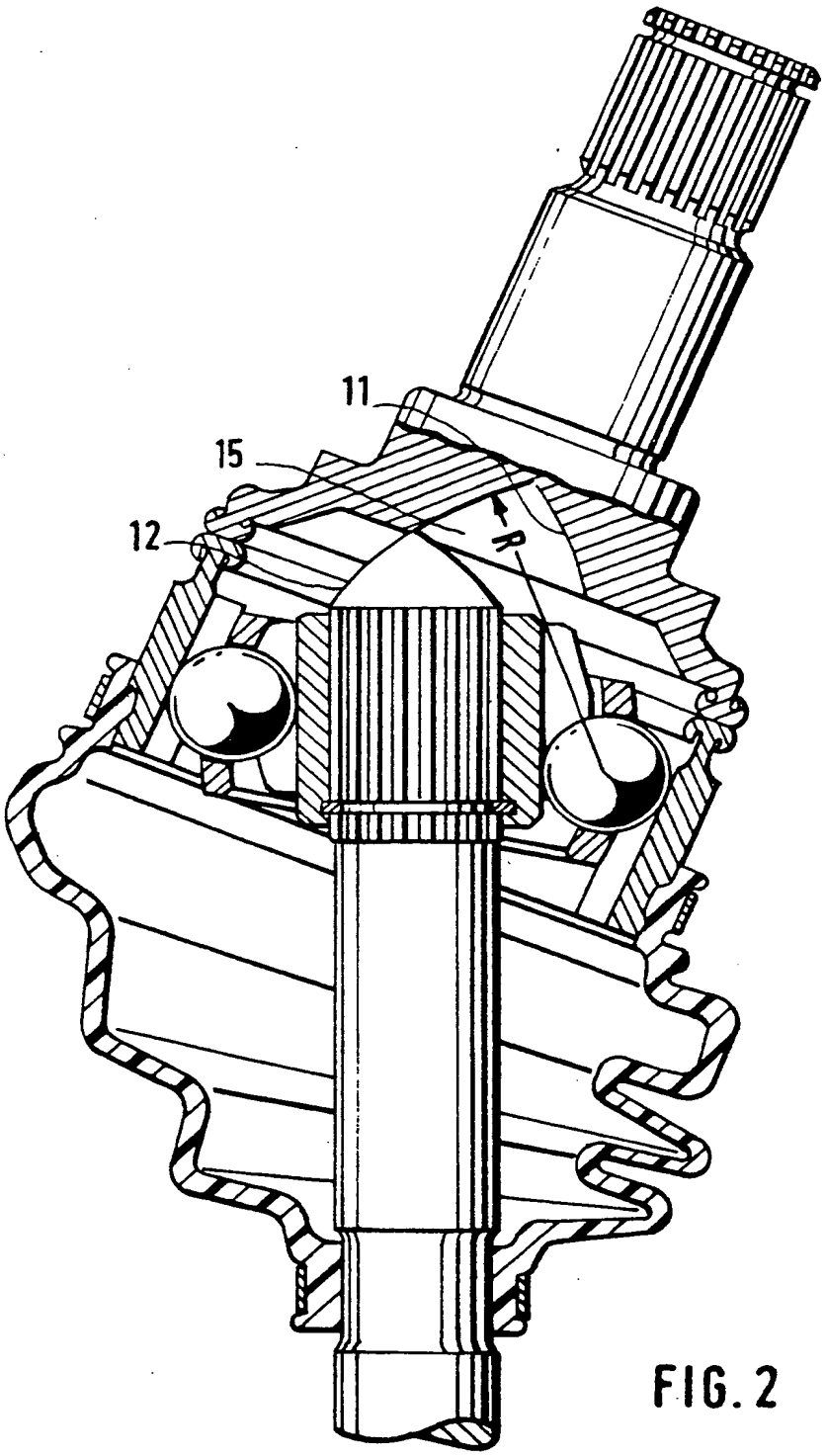

FIG. 2

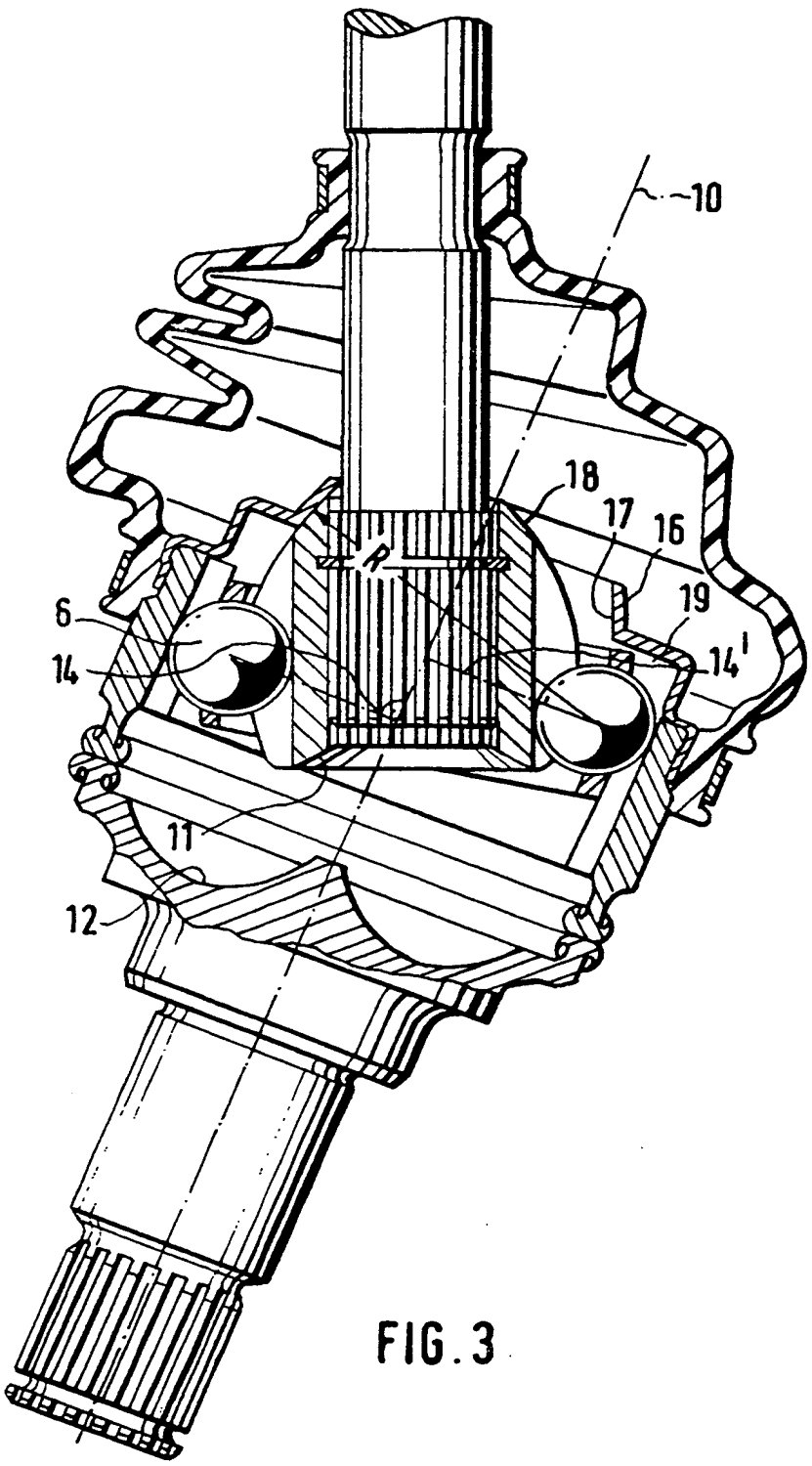

FIG.3

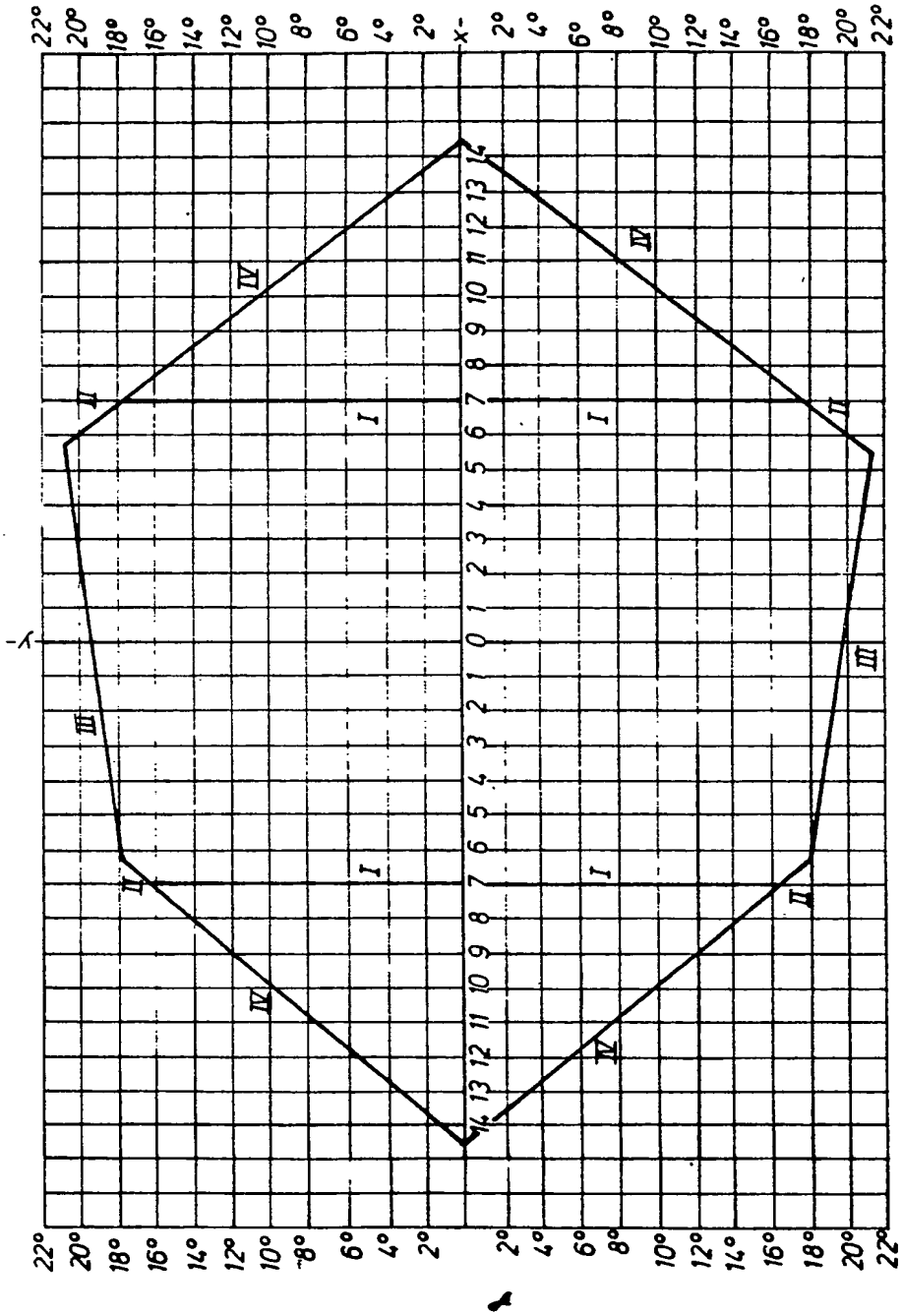

FIG.4

SPECIFICATION

Improvements in or Relating to Constant Velocity Ratio Joints

Description of Invention

This invention relates to a constant velocity ratio joint of the kind hereinafter referred to as of the kind specified, comprising an outer hollow joint member having an open end whereof the interior wall is provided with grooves, an inner joint member extending into said outer joint member from its open end and being arranged in said outer joint member and having its exterior wall provided with a plurality of grooves corresponding in number to the grooves in the outer joint member, the arrangement being such that in each case pairs of grooves in the outer and in the inner joint members jointly accommodate a torque-transmitting ball, the groove being in crossing relation and the balls being retained in radially open windows of a cage which is arranged between the inner and outer joint members, the balls lying in a plane which bisects the included angle between the axis of inner and outer joint members, and each of the windows extending peripherally over a portion of the cage circumference.

In joints of the kind specified, wherein the inner joint member is capable of plunging movement in respect of the outer joint member, it is necessary to restrict the plunging movement by means of suitable end stops. Such restriction is needed to prevent spontaneous dismantling of the joint under extreme loads, for example as are liable to occur when the joints are in half shafts of a vehicle and which arise are to be transmitted from the cage to the inner or outer joint member respectively at the end stops which limits the distance of sliding displacement.

West German Patent Nos. 1,211,871 and PS 1,232,411 decribe joints wherein the inner joint member is supported relative to the cage in spaced relationship thereto; the exterior surface of the inner joint member having a spherical region which has the same radius as the interior surface of the cage. In this way a wide area of surface contact between the cage and inner joint member is provided at the limits of plunging movement between the two joint members which provides an end stop to further plunging movement. If the inner surface of the cage is of mainly cylindrical form, an end stop will be obtained since the joints have intersecting ball tracks, in the event of plunging movement of the inner joint member relative to the outer joint member, the balls will bear, after a certain amount of plunging movement partially dependent on the width of cage windows, on the medial web of th cage which extends between two adjacent cage windows.

End stops of the first kind, namely where the inner joint member bears on the cage, have the drawback that they do not permit maximum utilisation of available plunging movement. The end stops associated with the second of the above mentioned arrangements wherein the balls bear on the central web of the cage are not designed to take up high axial forces and cage fractures are liable to occur even under medium load.

In addition to the foregoing, joints having end stops are described in French patent No. 1,436,511 and West German petty patent No. 1,951,360 wherein the inner joint member bears on the outer joint member and thus forms an end stop, however, this is no more than an angular limiting device because these joints do not permit plunging movement between inner and outer joint members.

It is an object of the present invention to provide a new or improved joint of the kind specified.

According to the present invention, we provide a joint of the kind specified characterised in that the outer joint member comprises an end stop face of concave cross-sectional shape extending around and concentric with the rotational axis of the outer joint member and co-acting with a counter-face of the inner joint member or its shaft, the concave cross-section of said end stop face having a generating radius whereof the centre is situated on a circle lying in a plane at right angles to the rotational axis of the outer joint member and passing through the centre of that one of the balls which, when the members of the joint are in a position to bring the end stop face and counterface into contact lies in a terminal position adjacent the end of the outer joint member nearest the end stop face.

For joints which operate predominantly in a telescoped condition and are subject to compression or thrust loads, preferably the end face is provided in the form of an annular recess and is arranged in the end face in the cavity of the outer joint member.

Such an arrangement ensures that compression or thrust forces will now be absorbed by the end stop in the interior of the constant velocity ratio joint so that the cage itself is relieved of the load.

For plunging joints which operate predominantly in a predominantly extended condition and where, in that event, axial forces will be effective in the sense of the traction or tension forces, preferably the end stop face takes the form of an annular element arranged in the open inner joint of the outer joint member. Thus traction forces will be absorbed by contact between the annular element and a counter-face on the inner joint member and the cage will avoid the application of load stresses which will lead to an increased service life of the joint, the reduction of loads applied to the cage being the vital factor in this respect.

Preferred embodiments of the invention will now be described by way of example only with reference to the accompanying drawings wherein:—

Figure 1 shows a joint with an end stop face in

the form of an annular recess in the interior cavity of the outer joint;

Figure 2 shows a joint with another form of end stop face;

Figure 3 shows a joint wherein the end stop face is designed to absorb tensile or traction forces;

Figure 4 is an angle-distance diagram, diagrammatically showing the relation between deflection angle and relative plunging movement.

The joint shown in Figure 1 is a constant velocity ratio joint which may be used with front-wheel drive motor vehicles, for transmitting torque from a driving unit drive shaft to an output shaft or from a drive shaft to a wheel. Further applications for this kind of joint will be found in machines generally for driving auxiliary systems, or in ship propulsion transmission shafts.

The constant velocity ratio joint shown in Figure 1 comprises an outer joint member 1 whereof the cylindrical bore 2 is provided with grooves 3. Received in said cylindrical bore 2 is an inner joint member 4 which is rigid with the drive shaft and whereof the exterior surface is likewise provided with grooves 5.

In each case one groove 3 and one groove 5 of outer 1 and inner 4 joint members cross or intersect one another and jointly receive one of a plurality of torque-transmitting balls 6.

Between the inner joint member 1 there is a cage 7 which is provided with circumferentially spaced apart windows 8 wherein the balls 6 are retained and which also directs the balls 6 into the angle-bisecting plane. The joint interior is sealed by a convoluted boot 9 which is secured to the drive shaft and to the outer joint member 1.

The outer joint member comprises an end stop face 11 which is concentric with its rotation axis 10 and co-acts with a counter-face 12. The end stop face 11 and the counter-face 12 are both of rotationally symmetrical form, the face 11 being designed as an annular recess in the interior of the outer joint member 1 and the counter-face 12 extending as an annular face at the inner end of the inner joint member 4.

The curvature at the end stop face 11 is generated by a radius, the centre point of which is situated on a circle lying in a plane at right angles to the rotational axis of the outer joint member 4 and which circle passes through the centre of that ball, which, when the members of the joint are in a position to bring the end stop face and counter-face into contact is in a terminal position adjacent the end of the outer joint member nearest the end stop face. The curvature of the counter-face 12 corresponds to that of the end stop face 11. Since the generating radius (R) generates a rotationally symmetrical end stop face 11, it is situated on a circle 14 which is at right angles to the rotation axis 10.

The constant velocity ratio joint shown in Figure 2 is also a plunging joint, corresponding to the joint shown in Figure 1 but modified in that the end stop face 11 is arranged in a bore 15. The end stop face 11 is of arcuate form and the centre of the generating radius (R) lies on a circle lying in a plane at right angles to the rotation axis of the outer joint member and passing through a ball in its terminal position. The counter-face 12 which co-acts with the end stop face 11 is also arcuate, just as in the case of the arrangement of Figure 1, and its curvature corresponds to the radius of the end stop face 11.

The above described arrangement permits the full plunging movement of the joint to be utilised without any risk of transmitting operational compression or thrust forces to the cage because in the event of angular deflection the counter-face 12 will engage the end stop face 11, thereby preventing the transmission of loads to the cage.

The joint shown in Figure 3, additionally to the end stop face 12 and matching counter-face 11, comprises a further end stop face to limit tension or traction forces. This end stop takes the form of an annular element 16 which presents a further stop face 17 directed towards the centre of the joint for absorbing tension forces, the generating radius (R) of said further stop face 17 has a centre lying in a plane at right angles to the rotation axis of the outer joint member and passing through the centre of that one of the balls 6 which, when the members of the joint are in a position to bring the end stop face and counter-face into contact lies in a terminal position. However, in this case the terminal position will be a position of a ball at the end of the outer joint member nearest the open end into which the inner joint member extends. The matching counterface 18 is arranged on the side of the outer joint member 1 facing the aperture region 19. Again this counter-face has a curvature which agrees with the generating radius (R). If the joint is subject to traction or tension, i.e. in the sense of length extension of the drive shaft, such tension force will be taken up by the annular element 16 thereby reducing the loud forces applied to the cage.

Figure 4 shows a diagram which illustrates the relation between the angle of deflection between the inner and outer joint members and the amount of plunging movement in a joint of the present invention. Plunging movement displacement distance is plotted on the X axis starting from zero, length extension of the drive shaft being represented on the positive side, whilst shortening of the drive shaft is represented on the negative side of the graph.

The deflection angle of the joint is plotted on the Y axis.

The limit line I on both sides, i.e. the positive and the negative side of the Y axis, is the line representing the limitation of relative plunging movement of the joint members afforded by the abutment of inner joint member 4 and cage interior without joint deflection.

The limit line III reflects the limitation afforded by abutment between the drive shaft 13 and the open end 19 of the outer joint member and more specifically when, under maximum angular deflection, the drive shaft 13 engages with the

edge of the open end 19 of the outer joint member 1.

The limit lines II which in each case interconnects lines I and III are established by the cage windows which in each case extend over part of the circumference, and this limitation arises from the fact that the ball grooves of inner and outer joint members intersect so that on displacement of the inner joint member 4 relative to the outer joint member 1, the balls 6 will travel circumferentially in the cage window but will be permitted to do so only until they hit against the web portions which separate successive windows 8 from one another.

In this diagram the said limit lines I, II and III define a quadrangle within which all movements, that is to say angular deflections as well as axial plunging displacement, can be confined. Thanks to the end stop system the edge of the open end 19 of the outer joint member 1.

The limit lines II which is each case interconnects lines I and II are established by the cage windows which in each case extend over part of the circumference, and this limitation arises from the fact that the ball grooves of inner and outer joint members intersect so that on displacement of the inner joint member 4 relative to the outer joint member 1, the balls 6 will travel circumferentially in the cage window but will be permitted to so so only until they hit against the web portions which separate successive windows 8 from one another.

In this diagram the said limit lines I, II and III define a quadrangle within which all movements, that is to say angular deflections as well as axial plunging displacement, can be confined. Thanks to the end stop system according to this invention freedom of movement is extended beyond line I along line II so that the maximally disposable distance of relative plunging displacement can be fully utilised, in other words, that line IV if formed by, or reflects, the co-action of end stop face 11 and counter-face 12, and/or end stop face 17 and counter-face 18. This is due to the fact that the outer diameter of the inner joint member 4 is smaller than the inner diameter of cage 7 thereby achieving unrestricted plungability but that the balls 6 will abut the webs of cage 7 owing to the angularly inclined grooves 3, 4. However, the web portions of the cage are relieved of forces by the stop faces 11, 12, 17 and 18.

The advantage of the joint of the present invention is that full utilisation of the total available plunging movement between the two joint members is possible and axial forces arising in the course of such relative plunging movement can be fully absorbed and are thus prevented from damagaing the joint. Thus, the danger of cage fracture is minimal.

Claims

1. According to the present invention we provide a joint of the kind specified and characterised in that the outer joint member comprises an end stop face of concave cross sectional shape extending around and concentric with the rotational axis of the outer joint member and co-acting with a counter-face of the inner joint member or its shaft, the concave cross section of said end stop face, having a generating radius whereof the centre is situated on a circle lying in a plane at right angles to the rotational axis of the outer joint member and passing through the centre of that one of the balls which, when the members of the joint are in a position to bring the end stop face and counter-face into contact lies in a terminal position adjacent the end of the outer joint member nearest the end stop face.

2. A constant velocity ratio joined as claimed in claim 1 characterised in that the end stop face comprises an annular recess in the outer joint member situated at the end of the outer joint member remote from its open end.

3. A constant velocity ratio joint as claimed in claim 1 characterised in that the end stop face is provided adjacent the open end of the outer joint member.

4. A constant velocity ratio joint as claimed in claim 3 characterised in that said end stop face comprises an annular element comprising a part of, or being attached to, the outer joint member.

5. A constant velocity ratio as claimed in any one of the preceding claims characterised in that the outer joint member is provided with an end stop face at each end thereof.

6. A constant velocity ratio joint as claimed in any one of the preceding claims characterised in that the or each counter-face provided on the inner joint member has a radius of curvature the same as its respective end stop face provided on the outer joint member.

7. A constant velocity ratio joint substantially as hereinbefore described with reference to those illustrated in Figure 1 of the accompanying drawings.

8. A constant velocity ratio joint substantially as hereinbefore described with reference to and as illustrated in Figure 2 of the accompanying drawings.

9. A constant velocity ratio joint substantially as hereinbefore described with reference to and as illustrated in Figure 3 of the accompanying drawings.

10. A constant velocity ratio joint including any novel feature of combination of features disclosed in the specification or illustrated in the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1979. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.